**DIRECT TESTIMONY**

**OF**

**CARL B. KLEIN**

**ON BEHALF OF**

**SOUTH CAROLINA ELECTRIC & GAS COMPANY**

**DOCKET NO. 2004-002-E**

**Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND POSITION.**

A. My name is Carl B. Klein. I am Manager of Economic Resource Commitment in the Power Marketing Division at South Carolina Electric and Gas Company. SCE&G Power Marketing is located at Suite 300, 246 Stoneridge Drive in Columbia.

**Q. DESCRIBE YOUR EDUCATIONAL BACKGROUND AND YOUR BUSINESS EXPERIENCE.**

A. I have a bachelor's degree in English from Davidson College (1966), a master's degree in English from Duke University (1972), and a master's degree in Economics, with a minor in Statistics, from North Carolina State University in 1982, with additional coursework in economics and econometrics through 1984.

I was employed in May 1984 in the Generation Planning group of the System Planning Department of SCE&G, where I produced seasonal peak demand forecasts for generation expansion planning, among other duties. In 1989 I was named Supervisor of Generation Planning. I continued in that role after Generation Planning was removed to Corporate Planning in 1994.

In 1996, I became Supervisor of the Operations Planning group in SCE&G's Transmission Planning and System Control Department, where I oversaw the engineering processes RNG involved in daily dispatch of SCE&G's plants for economics and reliability. I also oversaw the accounting processes involved in power transactions with other utilities and non-utility power marketers and purchases and sales of transmission services. In July 2001, many of the engineering aspects of the Operations Planning work were assigned to SCANA Energy Marketing, which acted as agent for SCE&G in its bulk power purchases and sales operations, and I was named manager of the group, renamed the Economic Resource Commitment group. In January 2004 the bulk power marketing functions of SCANA Energy Marketing, including the Economic Resource Commitment group, were transferred back within SCE&G.

I have provided testimony before this Commission on a number of previous occasions.

**Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

A. Because electricity supply must be continually matched to the ever-changing load, planning the details of that supply is a complex and continuous process. My testimony will describe the processes by which the Company predicts the changing load and plans its hourly, daily, and next-day to next-week supplies in a manner that assures cost efficiency in fuel and purchased power costs for its native load customers. I will also provide a detailed description of the methods we use to identify the generation production costs that are avoided whenever power is purchased from the wholesale market to serve our native load. Finally, I will explain how the transmission costs for power purchases figures into our decision-making and our accounting.

**Q. PLEASE DESCRIBE THE DAILY PROCESSES BY WHICH THE COMPANY DETERMINES THE FUEL USE AND POWER PURCHASES REQUIRED TO SERVE ITS RETAIL CUSTOMERS AND DESCRIBE ANY MEASURES TAKEN TO ASSURE EFFICIENCY IN THESE PROCESSES.**

A. First, we have to predict the electric load requirements, which continually change with the season, the hour of day, the day of the week, and, most important, the weather. The daily processes for ascertaining our generation and fuel requirements and/or our need for purchased power begin with development of hourly electric load forecasts, based on weather forecasts. Initially, every morning Company engineers download, from a commercial weather forecasting service, current forecasts of several weather variables for both the Charleston and Columbia areas, as well as actual observations for each variable at each location for each hour of the preceding day. Concurrently, engineers extract from SCE&G's Energy Management System (EMS) the actual native load requirements for each hour since the last update, never more than twenty-four hours previously. All the fresh data—historical loads, historical weather, and forecast weather—are then loaded into a database that feeds our forecasting models.

The Company uses several proprietary statistical forecasting models. We depend primarily on multiple regression techniques, although we sometimes also consider forecasts resulting from other methods. The separate forecasts for the current and six future days are then loaded onto an Excel spreadsheet which allows the forecaster to see each model's forecast for each day and decide how to combine or adjust the separate forecasts accordingly. The result is a single forecast of hourly loads for 168 hours, the current day and six days beyond.

**Q. ONCE THE SINGLE FORECAST SERIES IS DERIVED, WHAT IS THE NEXT STEP IN THE PROCESS?**

A. The new load forecast is then archived and loaded into the database that feeds the proprietary resource commitment software designed to conduct analyses to minimize costs. This optimization software has the objective of minimizing the sum of production plus purchase cost for SCE&G, subject to constraints. The first constraint that has to be satisfied is the load constraint—each hour's load has to be served, and it has to be served within that hour, so timing requirements govern many calculations. There are hundreds of other constraints that also have to be observed, including operational constraints (e.g., unit ramp rates, minimum up- or downtimes, mandated operations for equipment or environmental testing). There are environmental constraints (e.g., opacity at thermal plant stacks, river temperatures downstream from some coal-fired plants). There are ambient constraints (e.g., wet coal after heavy rains, reduced condenser efficiencies when temperature and humidity are high). There are system constraints (e.g., spinning and other operating reserve requirements). Within these and other categories of constraints and model run configurations there are literally hundreds of specific considerations. For example, there are maintenance schedules, price settings for dispatchable purchases, prescheduled exports, the eligibility of different units to provide different reserves, calculation method selections, and policy decisions.

Since the objective of the resource commitment software is to minimize production costs, it requires a great deal of data to calculate those costs. Fuel costs for each fuel that each unit can burn are updated at least monthly. Because we buy natural gas for electric generation on a daily basis we update gas prices daily. Thermal unit heat rate curves are updated as often as quarterly. The database for this model also has information regarding startup costs, shutdown costs, and variable operating costs. Moreover, allowance costs must be calculated for units emitting $SO_2$, so data on sulfur content of the fuels, emissions rates for the units, and allowance costs per ton of $SO_2$ emitted are all part of the database. It should be noted that the model has no information on fixed costs, since those costs are irrelevant for making short-run operating decisions.

The model also requires data on the system's situation at the start of the run, including the units on line, the availability status of units not currently on line (including hours since last on line for units with minimum downtimes), transactions that are ongoing or are currently scheduled, the energy currently stored in the upper pond of our pumped storage hydro facility, and similar information.

When the model operator has all the up-to-date input data, he or she can initiate a run. The results are reviewed carefully for any errors. The validated model output provides a plan for operating our resources (including starting units up and/or shutting units down) to meet our load at minimum variable cost, as long as all factors and conditions remain unchanged from the inputs that were modeled. However, since those factors and conditions do not remain unchanged, this forecasting and modeling process goes on more or less continually. The entire process is performed at least once every day and at least twice every weekday. The process may be initiated at any time, day or night, when there is a significant change to input assumptions.

**Q. AMONG THE EFFECTS OF LEGISLATION APPROVED BY THE GENERAL ASSEMBLY OF SOUTH CAROLINA ON FEBRUARY 10 AND SIGNED BY THE GOVERNOR OF SOUTH CAROLINA ON FEBRUARY 18 OF THIS YEAR, "FUEL COSTS RELATED TO PURCHASED POWER" INCLUDE ECONOMY PURCHASES, "PURCHASES MADE TO DISPLACE HIGHER COST GENERATION, AT A PRICE WHICH IS LESS THAN THE PURCHASING UTILITY'S AVOIDED VARIABLE COSTS FOR THE GENERATION OF AN EQUIVALENT QUANTITY OF ELECTRIC POWER." PLEASE EXPLAIN HOW THE COSTS AVOIDED BY A POWER PURCHASE CAN BE DETERMINED.**

A. We have several different methods that we use, depending on whether a purchase is small or large and whether the purchase is offered for the next hour or so or for the next day or so.

When a power marketer representing SCE&G is offered purchase terms for a small block of power for the next hour or few hours, he or she consults several sources of information to estimate the production costs that could be avoided. The marketer has access to real-time load and unit loading information through screens fed by SCE&G's energy management system (EMS). If the load is rising, the marketer looks to see what resources will be dispatched further because of the increasing load. Any unit already dispatched to its maximum, for instance, will be unaffected. But the marketer will be able to identify some resource or resources that can be loaded further. If there is any room available on coal-fired steam units, the marketer then consults a graph that depicts the $/MWH production cost for incremental generation from any unit at any point on its variable cost curve. (These graphs are updated at least monthly, with the receipt of monthly coal cost updates.) If the incremental generation will be from Fairfield Pumped Storage Hydro, the marketer has a daily report of the $/MWH cost of generation out of that resource (the cost changes daily with the daily generation and pumping cycle). If the incremental generation will be from gas turbines, the marketer consults tables to find the full-output $/MWH production cost, and checks report of the day's gas supply cost for each unit to verify that cost. Once the marketer has identified the avoidable resource and has read off or calculated the production cost per megawatt-hour from that resource, he or she has identified the avoided production cost.

If the load is level or decreasing over the hours of the purchase, the marketer consults the same information and carries out the same calculations, except that instead of considering which resources will otherwise have to move up with the load, he or she considers which resources, already loaded, can be backed down if the purchase is made.

If the offered purchase involves a large amount of energy, the avoided generation might be from a mix of several resources, such as some coal-fired steam and some pumped-storage hydro. In that case the marketer will have to combine several calculations and derive a weighted average avoided production cost to compare to the delivered cost of the power purchase. Whether the purchase is small or large, if it is cheaper than the generation it will displace, the marketer makes the purchase and records the all the accounting and scheduling details of the purchase, including the calculated avoided production cost, on the logsheets.

The foregoing real-time analyses are not appropriate, however, for purchases that are prescheduled a day or more in advance. For many reasons, including the prescheduling requirements of wholesale power pools and the needs of many generators to schedule their fuels (especially natural gas) in advance, power is frequently offered for sale a day or more in advance of delivery. Forward transactions like this help stabilize the market by settling many arrangements before matters get to the immediate hour-ahead or real-time markets, so there are often advantages for the sellers as well as the buyers in prescheduled transactions, and the prices offered our marketers are often attractive. In these cases marketers must turn to resource commitment engineers to perform avoided cost studies for them.

**Q. HOW DO THE RESOURCE COMMITMENT ENGINEERS PERFORM THOSE AVOIDED COST STUDIES?**

A. Resource commitment engineers always have a current resource commitment plan in place, including hourly detail of forecast system loads, planned loading levels of every resource in the dispatch plan, availability information on every resource not dispatched but available, and current production cost information for every resource over the whole range of its dispatch capability. This "base case" can be adapted to estimate the avoided production cost for any future purchase in the following way: the engineer creates a "change case" that is identical in terms of all its inputs to the base case except that over the hours of the proposed forward purchase the engineer reduces the forecast of system loads by the MW amount of the purchase in each hour. He or she then runs the model, which is designed to find the most economic dispatch of resources, subject to design and operating constraints. The model will yield among other results a total production cost for the period. The engineer will subtract the change case total cost from the base case total cost, and the difference will be the generation production cost avoided by the purchase. Dividing that dollar value by the total energy over all the hours of a purchase yields an average avoided cost in $/MWH that can be compared directly to the price offered for the purchase. That avoided cost will not necessarily correspond to the production cost of any one resource, because it is an average over several resources and several hours, but it will represent the upper ends of the cost curves for the units that were cut back because of the energy arriving from outside the system. As is the case with the next-hour purchases, both the purchase price and the average avoided cost are recorded on the daily log sheets and transferred to the electronic spreadsheet worksheet rows for each hour of the purchase.

**Q. HOW AND WHERE ARE THE GENERATION PRODUCTION COSTS AVOIDED BY A PURCHASE RECORDED?**

A. Marketers record avoided costs on the same logsheets as the other accounting and scheduling information for each transaction. When the information on the logsheets is combined with other information and transferred to electronic spreadsheet worksheets each purchase has a complete row entry for each hour, even the prescheduled block purchases. For an hour during which marketers made two purchases that served native load there will be two row entries, one for each purchase. When monthly summaries are prepared (the Unit Cost Sheets, among others), the MWHs and the dollars spent to acquire them are summed for the month by selling entity, and all the avoided costs are summed up as well. These records and the spreadsheets underlying them are reviewed by the Commission Staff. In those reviews the avoided costs for each transaction may be observed, and the summations can be repeated for verification. Marketer log sheets (the paper originals) are also retained.

**Q. ALL OF THIS ANALYSIS AND DATA RECORDING SOUNDS LIKE A GREAT DEAL OF WORK. WOULD IT BE POSSIBLE TO ESTIMATE ALL YOUR AVOIDED COSTS IN A SINGLE PROCESS, PERHAPS AT THE END OF THE MONTH, AND BY DOING SO SAVE SOME TIME AND EFFORT?**

A. It might be possible to come up with a single summary estimate of avoided costs, and that would save time for marketers, engineers, and accountants, but that would not be a good practice. Having to make the calculation and record the results for every purchase decision provides the best discipline for the "purchase-versus-generate" decisions that we have to make every day. The most economical energy supply for our customers can be achieved only by thoughtful case-by-case decision-making, and having to determine and record the generation production cost avoided by each purchase ensures that the thought process is timely, rigorous, and thorough.

**Q. THE SAME LEGISLATION MENTIONED EARLIER DEFINES "FUEL COSTS RELATED TO PURCHASED POWER" TO INCLUDE "THE TOTAL DELIVERED COST OF ECONOMY PURCHASES OF ELECTRIC POWER INCLUDING, BUT NOT LIMITED TO, TRANSMISSION CHARGES…" PLEASE DESCRIBE HOW ELECTRIC TRANSMISSION COSTS FIGURE INTO THE COST OF ECONOMY POWER PURCHASES THAT SERVE RETAIL CUSTOMERS.**

A. Power purchased from any distant supplier is no use to our native load customers unless it is delivered into our system, so the total delivered cost is the correct cost for us to test against the production cost of our system generation. And since the Federal Energy Regulatory Commission (FERC) redefined the business of interstate electric transmission in 1996, buyers and sellers of bulk power have had to arrange transmission services separately from their power transactions, and the owners of transmission systems have had to provide their services on a "common carrier" basis through FERC-approved Open Access Transmission Tariffs, using electronic bulletin board systems called "OASIS" ("Open Access Same-Time Information System"). Transmission costs are among the purchased power costs that we consider, but whether we consider them explicitly or implicitly depends on who makes the transmission service purchase.

When the marketers representing a seller and a buyer discuss a transaction, they always settle several important points, such as price, quantity, beginning and ending times, and the point of delivery (typically the interface between two interconnected transmission systems) for the power. The seller has responsibility for the cost and effort necessary to move the power to the point of delivery, and the buyer has responsibility for moving the power from the point of delivery. If a seller offers to sell a certain amount of power at a certain price for a certain period, delivered to our system, we compare that number directly to the generation production cost we can avoid on our system. In that case, we do not know the transmission component of the supplier's cost. We presume that the price is sufficient to cover all the supplier's costs, but suppliers in power markets regard their costs as confidential business information, and limit their discussion to prices.

In other cases we may consider making a purchase delivered at some point distant from our system and making separate arrangements with the transmission system or systems in between for completing the delivery to our system. We may do this for various business reasons, such as to secure a firmer transmission service than the seller of the power offers to provide, or to make use of a reservation that we already own, or sometimes to prevent the current extent of our power purchases from becoming too obvious in the market. When we make separate purchases of transmission paths we make a separate accounting of the transmission costs (commonly called "wheeling" costs). And when the economic analysis justifies making the power and transmission purchases, we then identify the wheeling costs as well as the power purchase price for economy transactions that serve our retail customers in the cost accounting we submit for recovery through these proceedings.

**Q. WHAT DOES SCE&G REQUEST OF THE COMMISSION IN THIS PROCEEDING?**

A. SCE&G respectfully requests that the Commission declare prudent the processes by which the Company makes its power purchases.

**Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

A. Yes, it does.